

CLAIMS

The claims defining the invention are as follows:

1. A method of selectively repairing the lining of a lined pipeline, said method involving the utilisation of a conveyance adapted to be receivable within the pipeline, said conveyance being adapted to be able to travel through the pipeline, said conveyance comprising an inspection means, an excising means, a debris removal means and an application means, said method comprising introducing said conveyance into the pipeline, said method further comprising: an inspection step which comprises causing the conveyance to travel along the length of the pipeline; inspecting the surface of the lining and identifying and locating damaged portions of the lining at locations along the pipeline; an excising step comprising moving said conveyance along the pipeline and at the locations identified by the inspection step excising the damaged portions of the lining from the pipeline; a debris removal step comprising causing said conveyance to travel along said length of the pipeline to remove the debris left in the pipeline by the excising step; and an application step comprising causing said conveyance to travel along the said length of the pipeline and applying a fresh lining composition onto the lining to replace the excised portions of lining removed by the excising step.
2. A method of selectively repairing the lining of a lined pipeline as claimed at claim 1 which further comprises cutting a length of pipe from the pipeline at a position to provide a gap in the pipeline at the location, locating a support tray between the opposed ends of the remaining pipeline to span the lower portion of the gap and to provide a continuation of the lower surface of the pipeline across the gap.
3. A method of selectively repairing the lining of a lined pipeline as claimed at claim 2 wherein the pipeline is above the ground at the position.

5 4. A method of selectively repairing the lining of a lined pipeline as claimed at
claim 2 wherein the pipeline is buried at the position and the method further
comprises exposing the length of pipe at the position prior to the length of
10 pipe being cut from the pipeline.

5 5. A method of selectively repairing the lining of a lined pipeline as claimed at
any one of the preceding claims wherein said conveyance means comprises a
15 plurality of self propelled and self powered vehicles which comprise: at least
one inspection vehicle for said inspection step; an excising vehicle for said
excising step; at least one removal vehicle for said removal of debris step;
20 10 and at least one application vehicle for said application step.

6. A method of selectively repairing the lining of a lined pipeline as claimed at
25 claim 5 wherein at least some of the vehicles are operated remotely.

7. A method of selectively repairing the lining of a lined pipeline as claimed at
30 claim 5 or claim 6 wherein all of the vehicles operated remotely.

15 8. A method of selectively repairing the lining of a lined pipeline as claimed at
claim 5 or 6 wherein at least one of the vehicles is provided with a support to
enable the operator to be supported by the vehicle and is adapted to be
35 operated by an operator in-situ in the pipeline and the vehicle incorporates
controls operable by the operator to effect at least some of the operations of
20 the vehicle.

40 9. A method of selectively repairing the lining of a lined pipeline as claimed at
claim 8 wherein the at least one vehicle is associated with an operator trolley
which provides said support to enable the operator to be supported by the
45 vehicle and said controls.

25 10. A method of selectively repairing the lining of a lined pipeline as claimed at
claim 8 wherein the at least one vehicle is associated with an operator vehicle
50 which is coupled to the at least one vehicle wherein the operator vehicle is

5 provided with a support to enable the operator to be supported by the
operator vehicle.

10 11. A method of selectively repairing the lining of a lined pipeline as claimed at
claim 10 wherein the operator vehicle is provided with the controls.

15 5 12. A method of selectively repairing the lining of a lined pipeline as claimed at
any one of the preceding claims wherein said inspection step comprises
causing the inspection vehicle to travel along the interior of the pipeline and
during such travel inspecting the lining within the pipeline, identifying
20 locations of damaged or deteriorated lining.

10 13. A method of selectively repairing the lining of a lined pipeline as claimed at
claim 12 wherein the inspection step is conducted remotely and a log is
25 maintained to record the position of said locations in the pipeline and the type
of damage.

30 14. A method of selectively repairing the lining of a lined pipeline as claimed at
15 claim 12 wherein the inspection step involves utilisation of an operator
supported on the inspection vehicle, said operator being skilled in identifying
the damaged or deteriorated portions of the lining, said identifying of
35 damaged or deteriorated lining including the operator providing markings on
the lining to indicate the locations.

40 20 15. A method of selectively repairing the lining of a lined pipeline as claimed at
any one of the preceding claims wherein said excising step comprises
utilisation of a nozzle connected to a source of high pressure fluid whereby
said nozzle is able to be moved to direct a jet of said high pressure fluid over
45 the surface of the lining, said remotely controlled nozzle being supported from
25 the excising vehicle, said method causing the excising vehicle to travel along
the interior of the pipeline and during such travel causing the nozzle to direct
said jet of said high pressure fluid onto the lining at the locations in order to
50 remove the lining at said locations.

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16.A method of selectively repairing the lining of a lined pipeline as claimed at claim 15 wherein the excising vehicle is associated with a remote control station which is provided with a display means and controls to enable the remote operation of the vehicle and the nozzle from the control station by an operator.

17.A method of selectively repairing the lining of a lined pipeline as claimed at any one of the preceding claims wherein said debris removal step comprises causing a removal vehicle to travel along the interior of the pipeline and causing the removal vehicle to collect debris from the interior of the pipeline as it travels.

18.A method of selectively repairing the lining of a lined pipeline as claimed at claim 17 wherein the removal step initially comprises causing a primary removal vehicle to travel along the interior of the pipeline, scooping said large items from the pipeline as it travels along the pipeline and conveying the items into a hopper associated with the primary removal vehicle.

19.A method of selectively repairing the lining of a lined pipeline as claimed at claim 17 or 18 wherein said debris removal step further comprises causing a secondary removal vehicle to travel along the interior of the pipeline and causing the secondary removal vehicle to brush the surface of the pipeline to extract smaller items of debris from the pipeline.

20.A method of selectively repairing the lining of a lined pipeline as claimed at claim 17, 18 or 19 wherein said debris removal step further comprises causing a tertiary removal vehicle to travel along the interior of the pipeline and causing the tertiary removal vehicle to wash and vacuum fine debris and water from the pipeline.

21.A method of selectively repairing the lining of a lined pipeline as claimed at any one of the preceding claims wherein said application step comprises causing the application vehicle to travel along the length of the pipeline and

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causing the application vehicle to applying the fresh lining composition to the locations at which the lining has been excised.

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22. A method of selectively repairing the lining of a lined pipeline as claimed at claim 21 wherein the lining composition is applied to a location by spraying
5 utilising a directional nozzle.

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23. A method of selectively repairing the lining of a lined pipeline as claimed at claim 21 wherein the lining composition is applied around the interior circumference of the pipeline by a centrifugal application of the lining
20 composition.

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- 10 24. A method of selectively repairing the lining of a lined pipeline as claimed at claim 21 or 22 or 23 wherein the method further comprises the delivery of lining composition to the application vehicle during the application of the lining composition to the pipeline.

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- 15 25. A method of selectively repairing the lining of a lined pipeline as claimed at claim 24 wherein the lining composition is delivered to the application vehicle by a delivery vehicle which is adapted to be able to travel through the pipeline and carry a quantity of lining composition to the application vehicle, said
35 delivery vehicle having a conveying means adapted to be able to convey the lining composition from the delivery vehicle to the application vehicle.

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- 20 26. A method of selectively repairing the lining of a lined pipeline as claimed at any one of the preceding claims wherein the lining composition comprises a cementitious composition.

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27. A method of selectively repairing the lining of a lined pipeline substantially as herein described.

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- 25 28. A conveyance for use in the selective refurbishment of the lining of a lined pipeline according to the method described above, said conveyance

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5 comprising a plurality of vehicles capable of independently travelling along the
pipeline for the purposes of inspection, excising damaged lining, removal of
10 debris and application of a fresh lining composition, each of said vehicles
being configured such that their centre of gravity when in use is below the
5 central longitudinal axis of the pipeline and each of said vehicles being self
powered and self propelled.

15 29. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 28 wherein a plurality of self propelled and self
powered vehicles which comprise: an inspection vehicle for said inspection
20 10 step; an excising vehicle for said excising step; at least one removal vehicle
for said removal of debris step; and at least one application vehicle for said
application step.

25 30. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 29 wherein at least some of the vehicles are
15 adapted to be operated remotely.

30 31. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 29 and 30 wherein all of the vehicles are adapted
to be operated remotely.

35 32. A conveyance for use in the selective refurbishment of the lining of a lined
20 pipeline as claimed at claim 29 and 30 wherein at least one of the vehicles is
provided with a support to enable the operator to be supported by the vehicle
40 and is adapted to be operated by an operator in-situ in the pipeline and the
vehicle incorporates controls operable by the operator to effect at least some
of the operations of the vehicle.

45 25 33. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 32 wherein the at least one vehicle is associated
50 with an operator trolley which provides said support to enable the operator to
be supported by the vehicle and said controls.

5 34. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 32 wherein the at least one vehicle is associated
10 with an operator vehicle which is coupled to the at least one vehicle wherein
the operator vehicle is provided with a support to enable the operator to be
5 supported by the operator vehicle.

15 35. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 34 wherein the operator vehicle is provided with
the controls.

20 36. A conveyance for use in the selective refurbishment of the lining of a lined
10 pipeline as claimed at any one of claims 29 to 35 wherein the inspection
vehicle incorporates an illumination means and a viewing means which
comprises at least one camera adapted to facilitate inspection of the lining of
25 the pipeline remotely.

30 37. A conveyance for use in the selective refurbishment of the lining of a lined
15 pipeline as claimed at any one of claims 29 to 36 wherein the excising vehicle
accommodates a nozzle which is supported to be capable of rotation about a
longitudinal axis of said pipeline whereby said nozzle is adapted to be able to
direct a stream of high pressured fluid onto the lining to remove the lining from
35 the pipe interior.

40 38. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 37 wherein the excising vehicle is associated
with a remote control station which is provided with a display means and
controls to enable the remote operation of the vehicle and the nozzle from the
control station by an operator.

45 39. A conveyance for use in the selective refurbishment of the lining of a lined
25 pipeline as claimed at claim 38 wherein the excising vehicle is associated with
a delivery conduit for said high pressure fluid and an umbilical providing
connection between the control station and the excising vehicle.
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5 40. A conveyance for use in the selective refurbishment of the lining of a lined pipeline as claimed at claim 37 or 38 or 39 wherein the excising vehicle further comprises an illumination means and a viewing means comprising at least one camera to facilitate remote inspection of the location being subjected to the action of said stream of high pressure fluid.

15 41. A conveyance for use in the selective refurbishment of the lining of a lined pipeline as claimed at claim 37 or 38 or 39 or 40 wherein the high pressure stream of fluid incorporates abrasive particles.

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10 42. A conveyance for use in the selective refurbishment of the lining of a lined pipeline as claimed at claim 37 or 38 or 39 or 40 or 41 wherein the orientation of the stream to the surface of the pipeline can be adjusted to effect various degrees of wash.

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30 15 43. A conveyance for use in the selective refurbishment of the lining of a lined pipeline as claimed at claim 37 or 38 or 39 or 40 or 41 or 42 wherein the excising vehicle incorporates a second nozzle which is directed onto the lower portion of the pipeline forward of the vehicle, wherein the second nozzle generates a jet of fluid having a transverse extent.

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20 44. A conveyance for use in the selective refurbishment of the lining of a lined pipeline as claimed at any one of claims 29 to 43 wherein the debris removal vehicle is adapted to travel along the pipeline and collect the debris generated by the excising step from the pipeline wherein the vehicle is adapted to remove large and small items of debris and/or water from the pipeline.

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25 45. A conveyance for use in the selective refurbishment of the lining of a lined pipeline as claimed at claim 44 wherein the debris removal vehicle comprises a plurality of vehicles comprising a primary removal vehicle adapted to remove the large items of debris from the pipeline and a secondary removal vehicle for removal of the smaller items and/or water from the pipeline.

5 46. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 45 wherein the debris removal vehicle also
10 comprises a tertiary removal vehicle for the removal of fine material and/or
water from the pipeline.

5 47. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 45 or 46 wherein the primary removal vehicle
15 comprises a scooping means, a conveying means and a hopper said scooping
means being adapted to scoop larger items of debris from the pipeline, the
conveying means being adapted to convey the items from the scooping
20 10 means to the hopper.

25 48. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 45 or 46 or 47 wherein the secondary removal
vehicle comprises a brushing means, a vacuum extraction means and a
hopper, said brushing means being adapted to brush the lower surface of the
15 15 pipeline, the vacuum extraction means being adapted to convey the debris
30 dislodged by the brush and/or residual water to the hopper.

35 49. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 46 and any one of claims 47 and 48 as
dependant from claim 44 wherein the tertiary removal vehicle comprises a
20 20 washing means, a vacuum extraction means and a hopper, said washing
means being adapted to wash debris from the surface of the pipeline, the
vacuum extraction means being adapted to convey the debris and/or water to
40 the hopper.

45 50. A conveyance for use in the selective refurbishment of the lining of a lined
25 25 pipeline as claimed at any one of claims 29 to 44 wherein the debris removal
vehicle comprises a single vehicle incorporating scooping means, a brushing
means, a washing means, a conveying means, a vacuum extraction means
50 and a hopper, said scooping means being adapted to scoop larger items of
debris from the pipeline, the conveying means adapted to convey the items to
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5 the hopper, the brushing means adapted to brush the lower surface of the
10 pipeline, the washing means adapted to wash fine materials from the surface
of the pipeline, the vacuum extraction means associated with the brushing
5 means and washing means to convey materials dislodged by the brushing
means and the washing means to the hopper.

15 51. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at any one of claims 29 to 50 wherein the application
vehicle comprises a hopper adapted to accommodate a quantity of said lining
20 10 composition, a pump means for pumping said lining composition, an outlet
which is capable of directing said lining composition onto the surface of the
pipeline.

25 52. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 51 wherein a delivery means is provided between
the hopper and the pump and the delivery means is adapted to deliver the
15 lining composition to the pump.

30 53. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 51 or 53 wherein the application vehicle is
associated with a delivery vehicle having a hopper and a conveying means
35 whereby said delivery vehicle can be brought into abutting relationship with
20 the fourth vehicle whereby the conveying means can deliver lining
composition from the hopper of the delivery vehicle to the hopper of the
40 application vehicle.

45 54. A conveyance for use in the selective refurbishment of the lining of a lined
pipeline as claimed at claim 51 or 52 or 53 wherein the application vehicle
25 includes an operator trolley which is adapted to accommodate an operator,
wherein said outlet is supported from an operator trolley and is adapted to be
50 controlled by the operator.

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55. A conveyance for use in the selective refurbishment of the lining of a lined pipeline as claimed at any one of claims 29 to 54 wherein the inspection vehicle and excising vehicle comprise a single vehicle.

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56. A conveyance for use in the selective refurbishment of the lining of a lined pipeline substantially as herein described.

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